

Climatic Zones and Types

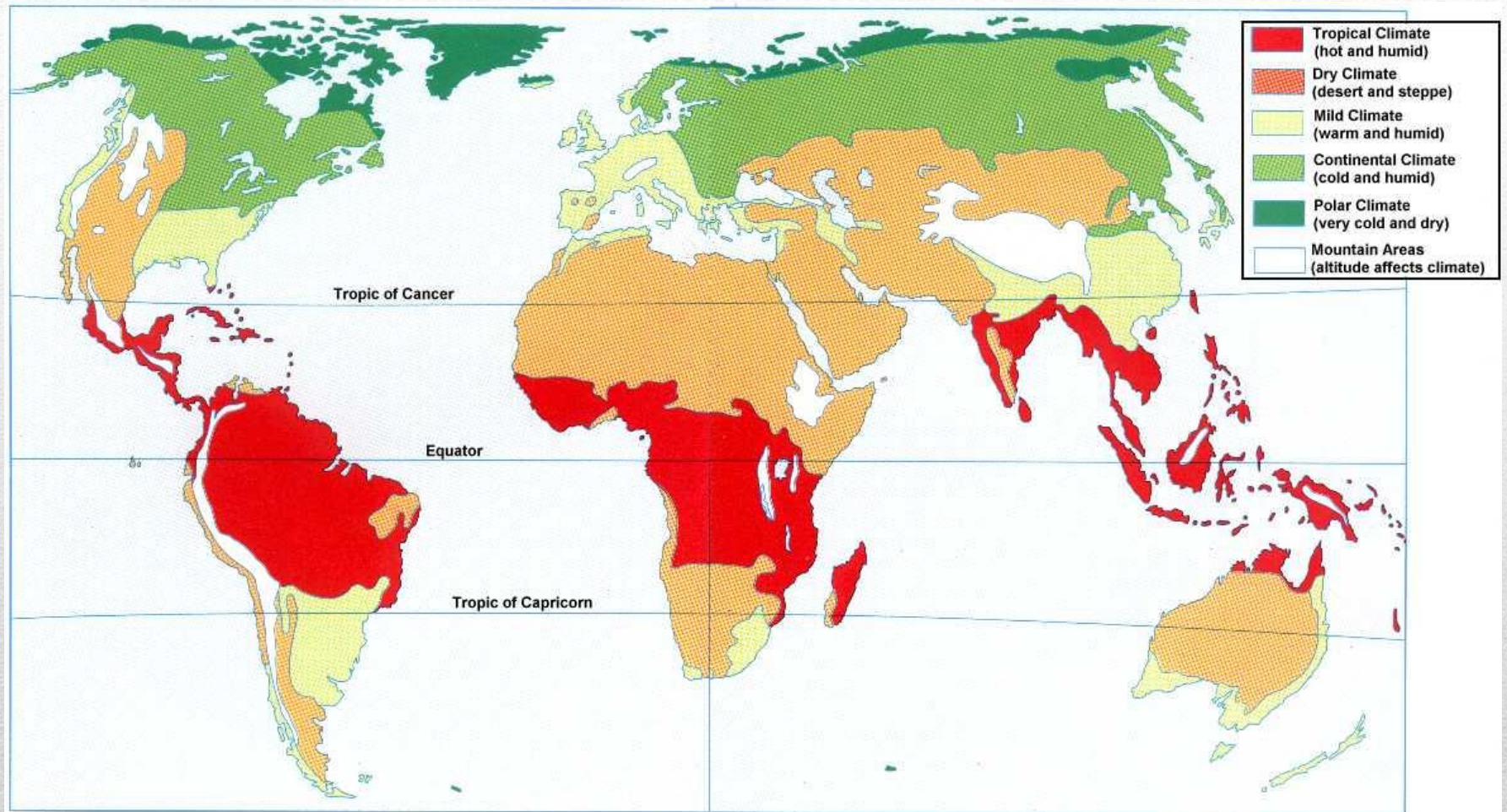
Chapter 8

Early Classification Schemes

- **Greeks “known world”**
 - **Temperate Zone**
 - **Mid Latitudes**
 - **Torrid Zones**
 - **Tropics to the south**
 - **Frigid Zone**
 - **Areas to the north**
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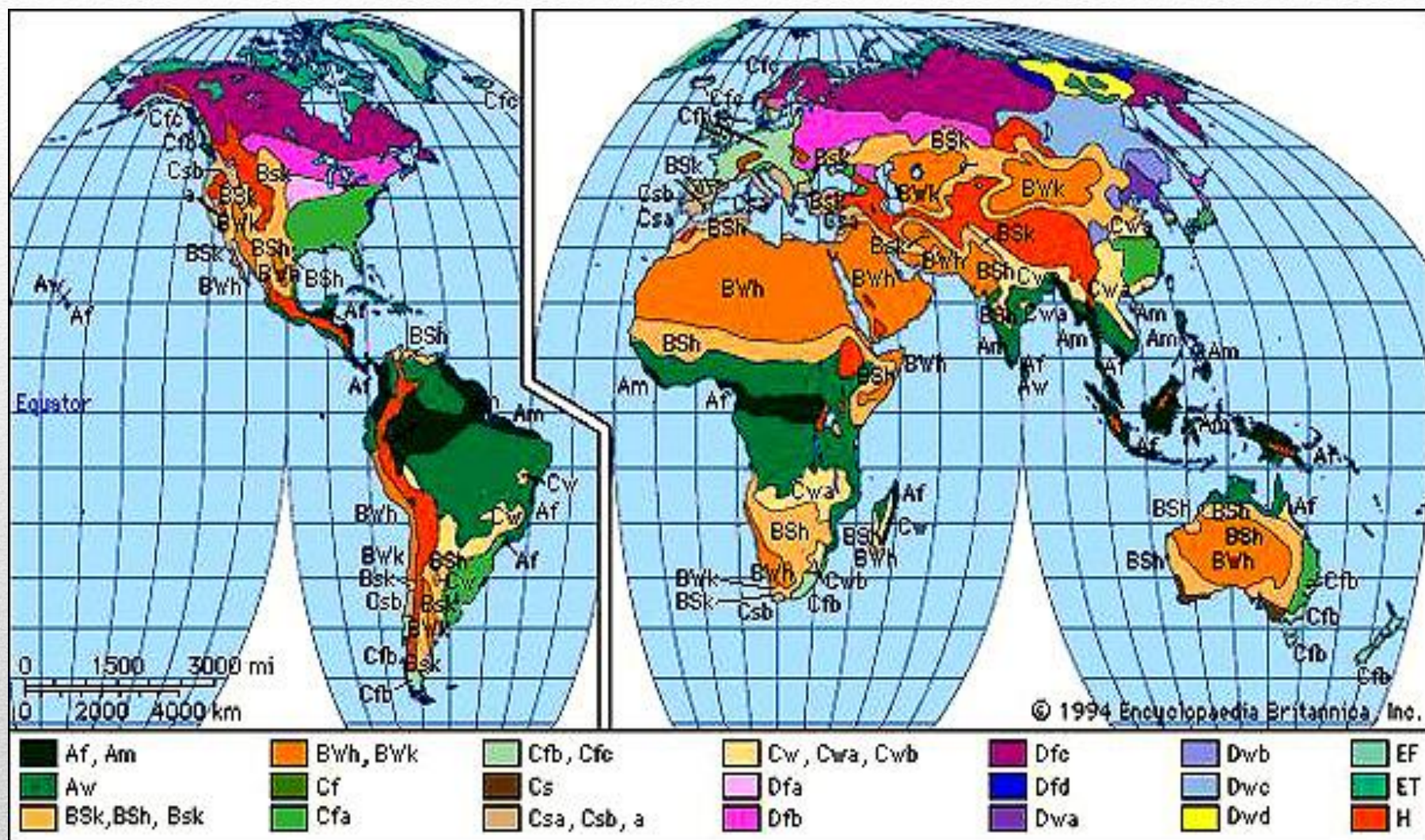
Today's Climate Zones

- **Equatorial warm-wet**
 - **Tropical hot-dry**
 - **Subtropical warm**
 - **Warm temperate**
 - **Mid Latitude cool temperate**
 - **High-latitude cold**
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Koppen Climate Classification System

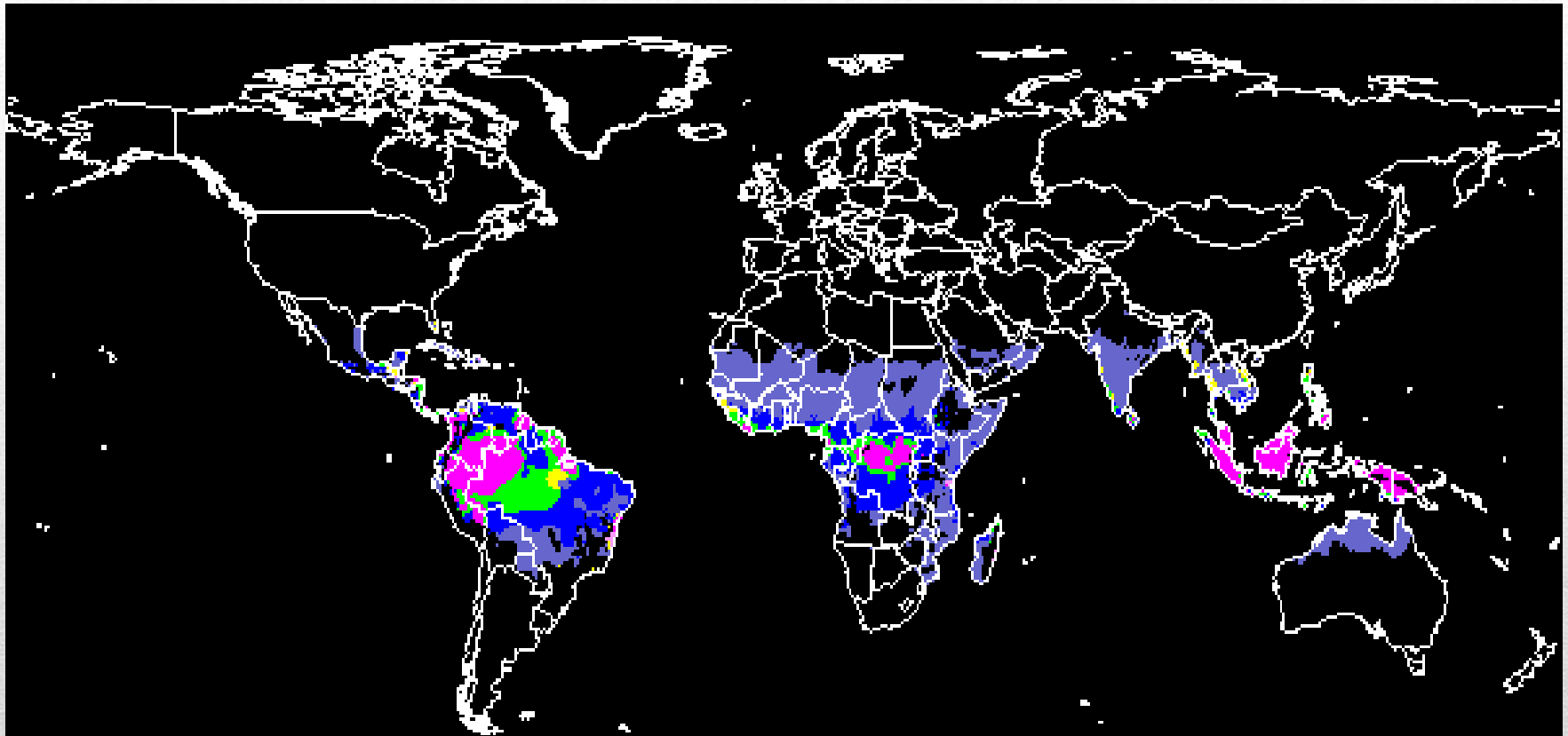
- Uses a database based on the average annual and average monthly values of temperature and precipitation
 - **Four of the five major climatic groups defined by temperature characteristics, fifth (the B class) is based on moisture.**
 - **Subdivided on relationships of precipitation and temperature**
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Modified Koppen System

- **Five Major Climate groups**
 - **A, B, C, D, E**
 - **Each Major Group** subdivided into **14** individual climate types
 - **Special category of “highland” climate**
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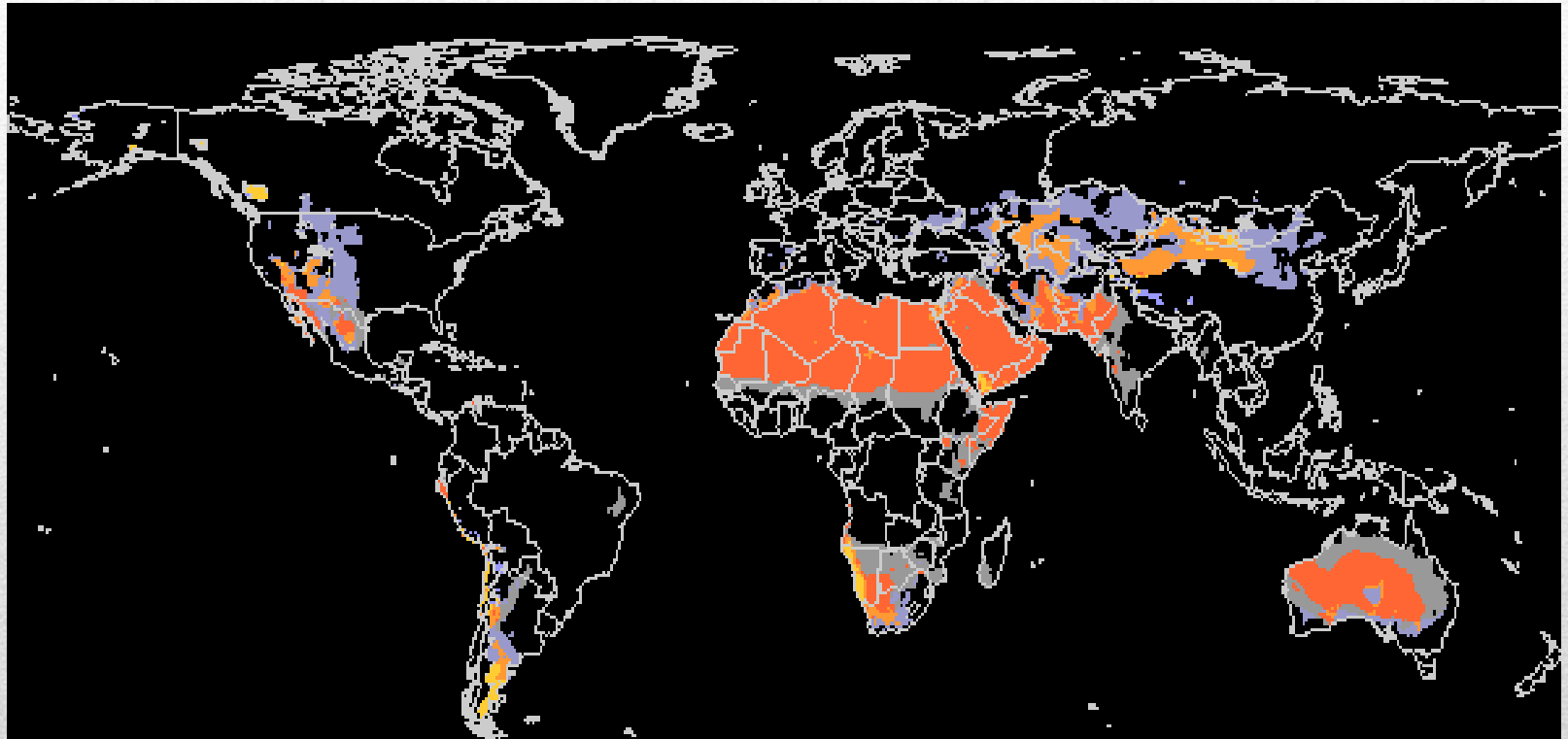
“A” Climate: Tropical Moist



Koeppen's Climate Classification: Class A: Tropical

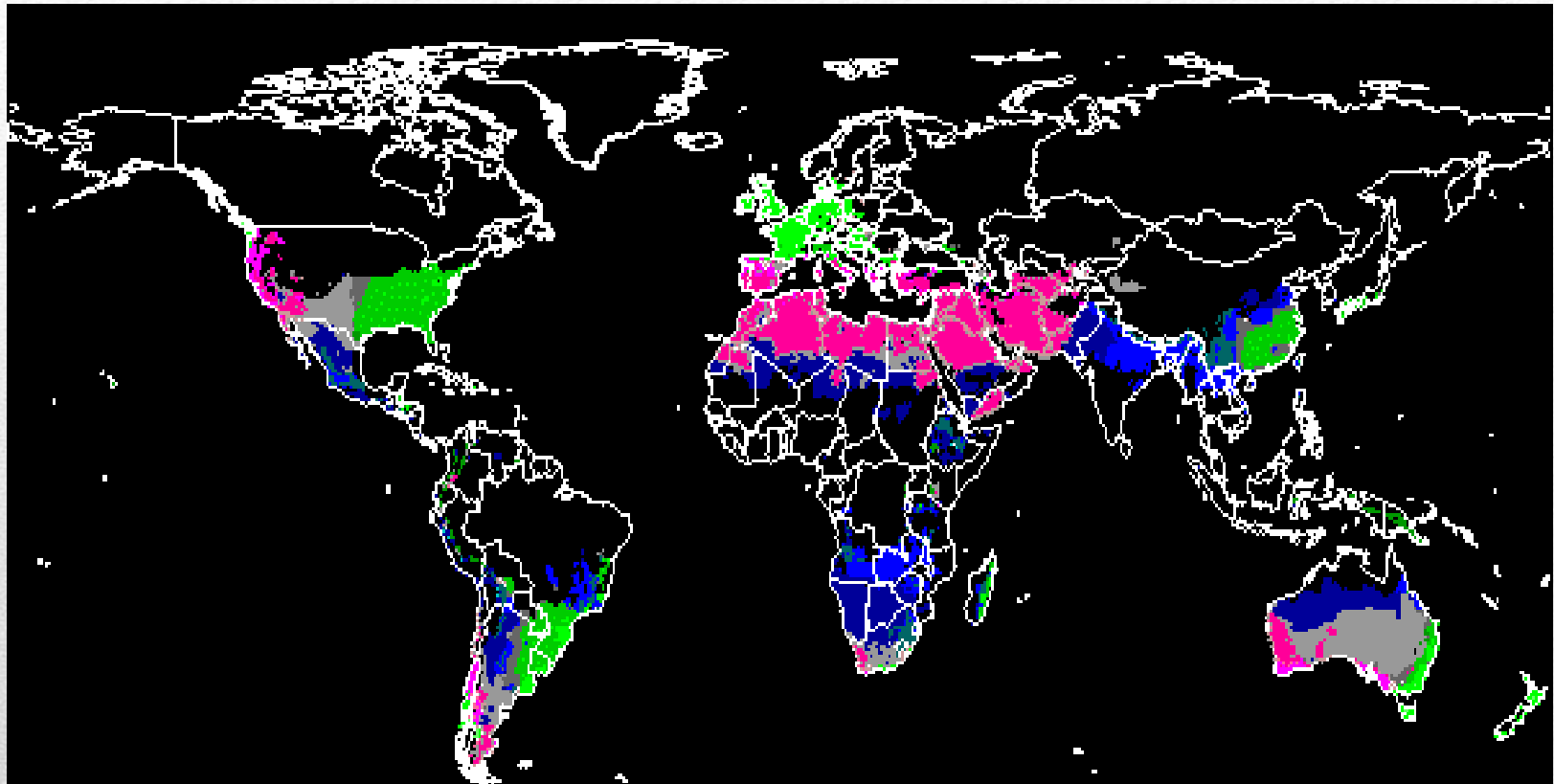
by FAO - SDRN - Agrometeorology Group - 1997

“B” Climate: Dry



Koeppen's Climate Classification: Class B: Dry
by FAO - SDRN - Agrometeorology Group - 1997

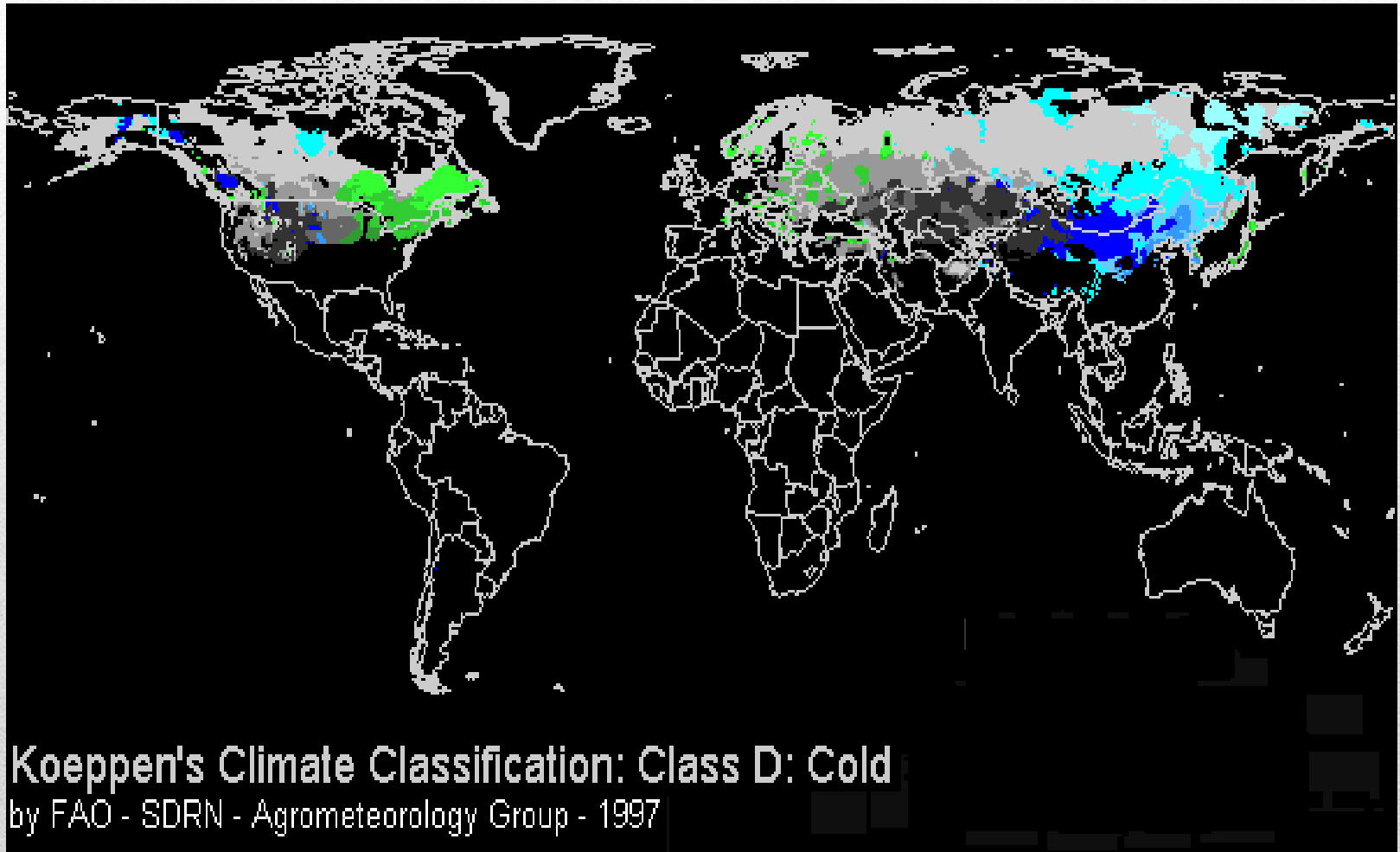
“C”: Climate: Temperate, Mild, Mid Latitude



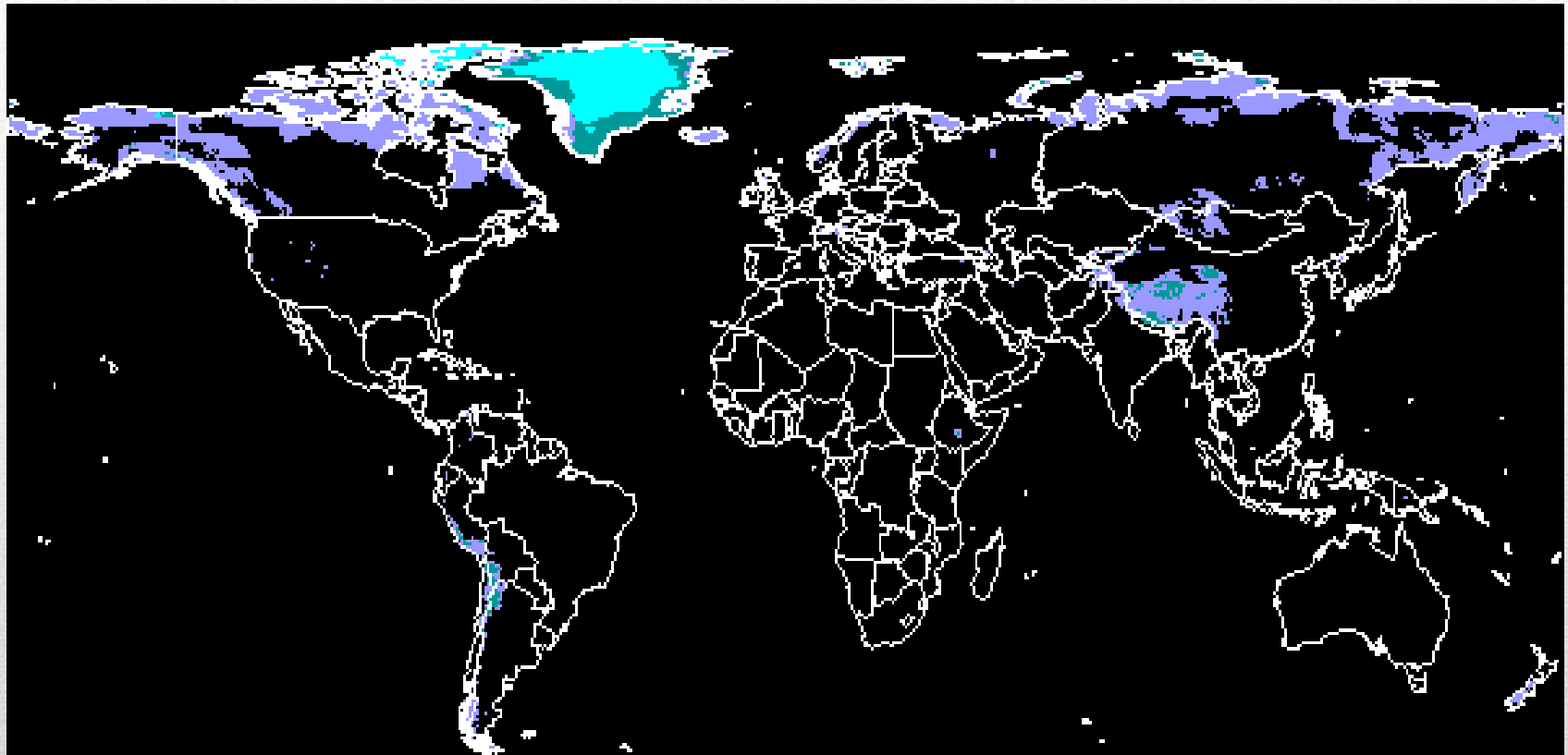
Koeppen's Climate Classification: Class C: Temperate

by FAO - SDRN - Agrometeorology Group - 1997

“D” Climate: Cold, Severe Mid Latitude



“E” Climate: Cold, Polar

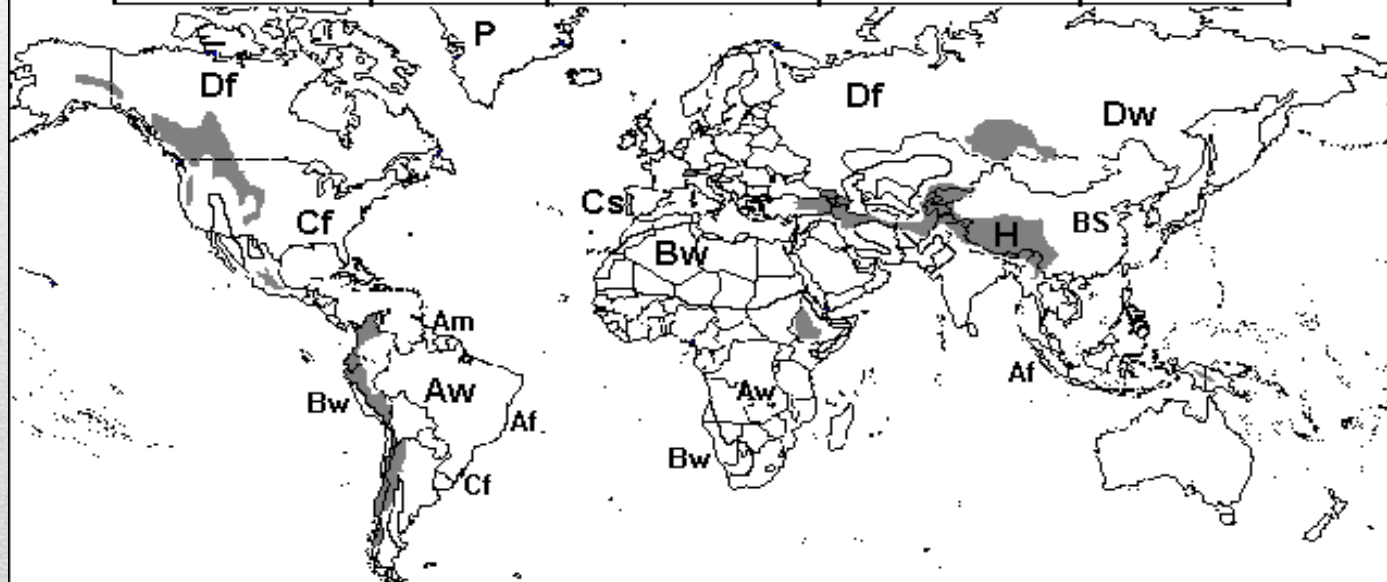


Koeppen's Climate Classification: Class E: Polar

by FAO - SDRN - Agrometeorology Group - 1997

“H” Climate: Highland

A-humid equat.	B-dry	C-humid temp.	D-humid cold	H-highlands
Af No Dry Season	Bs Semiarid	Cf No Dry Season	Df No Dry Season	H
Aw Short Dry Season	Bw Arid	Cw Dry Winter	Dw Dry Winter	P - Polar
Am Dry Winter		Cs Dry Summer		P



Koppen Letter Code System

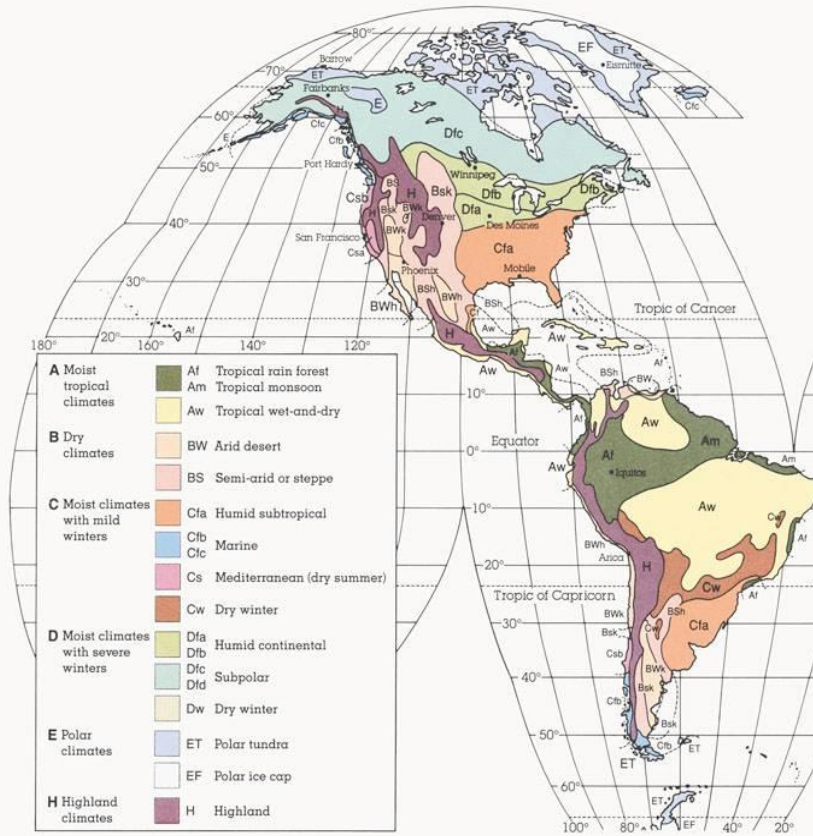
- **A** Tropical Humid
 - Low latitude, warm and wet
 - **B** Dry
 - Evaporation exceeds precipitation
 - **C** Mild Mid-latitude
 - Mild winters, warm or hot summers
 - **D** Severe Mid-latitude
 - Severe, cold winters, cool summers
 - **E** Polar
 - Very high latitude, cold climates
 - **H** Highland
 - High mountains; elevation is dominant control
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Second letters

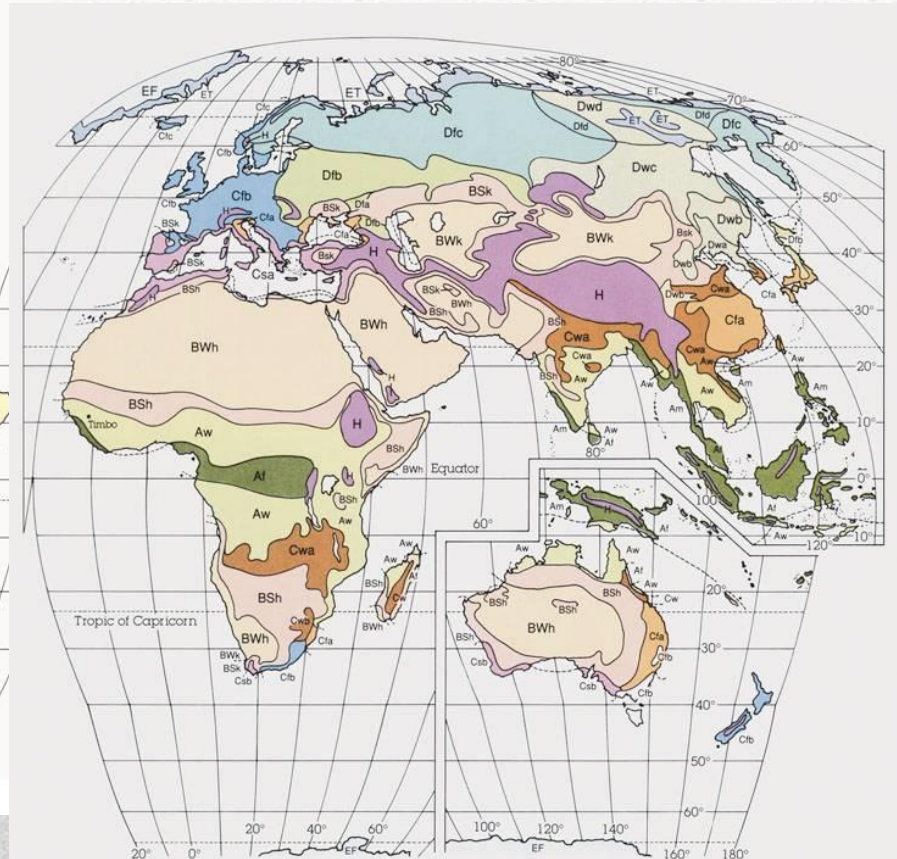
- **A, C, & D Climate Precipitation**
 - **f** – wet all year
 - **m** – monsoonal precipitation pattern (very wet summer)
 - **w** – winter dry season
 - **s** – summer dry season
 - **B Climate Precipitation**
 - **W** – desert
 - **S** – steppe
 - **E Climate Temperature**
 - **T** – tundra
 - **F** – ice cap
-

Third Letters

- **C and D Climates' temperature**
 - **a** – hot summers
 - **b** – warm summers
 - **c** – cool summers
 - **d** – very cold winters
 - **B Climate Temperature**
 - **h** –hot desert or steppe
 - **k** – cold desert or steppe
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Tropical Humid Climate (Group A)

- **Tropical Wet (Af)**
 - 5 -10 degrees of the equator
 - Warm all year
 - No dry season
 - Controlled by the trade wind convergence
- **Tropical savanna (Aw)**
 - Fringe of 25 degrees N or S
 - Warm to hot all year
 - Distinct wet and dry seasons
 - Seasonal shifting of tropical wind and pressure belts



Tropical Humid Climate (Group A)

- **Tropical monsoon (Am)**
 - Windward tropical coasts of Asia, Central and South America, Guinea Coast of Africa
 - Temperature similar to Af with a slightly larger Average Temperature Rate (ATR)
 - Very wet summer , short winter dry season
 - Seasonal wind direction reversal
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Af- Tropical moist climates



Aw- Wet-dry climates

Bw- Dry tropical climates



Dry Climates (Group B)

- **Subtropical desert (BWh)**
 - Very hot summers, relative mild winter
 - Rainfall Scarce
 - Subsidence from subtropical highs; cool ocean currents
 - **Subtropical Steppe (BSh)**
 - Fringing BWh except on west
 - Centered at latitudes 25-30 on western sides of continents
 - Temperature similar to BWh but more moderate
 - Semiarid
 - Similar to BWh
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Dry Climates (Group B)

- **Mid latitude desert (BWk)**
 - Central Asia; western interior of United States; Patagonia
 - Hot summers, cold winters
 - Meager, erratic precipitation, mostly showery; some winter snow
 - Distant from sources of moisture; some rain shadow effects
 - **Mid latitude steppe (BSk)**
 - Peripheral to BWk; transitional to more humid climates
 - Temperature similar to BWk but slightly more moderate
 - Semiarid; some winter snow
 - Similar to BWk
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Bs-Dry Mid latitude Climate (Steppe)

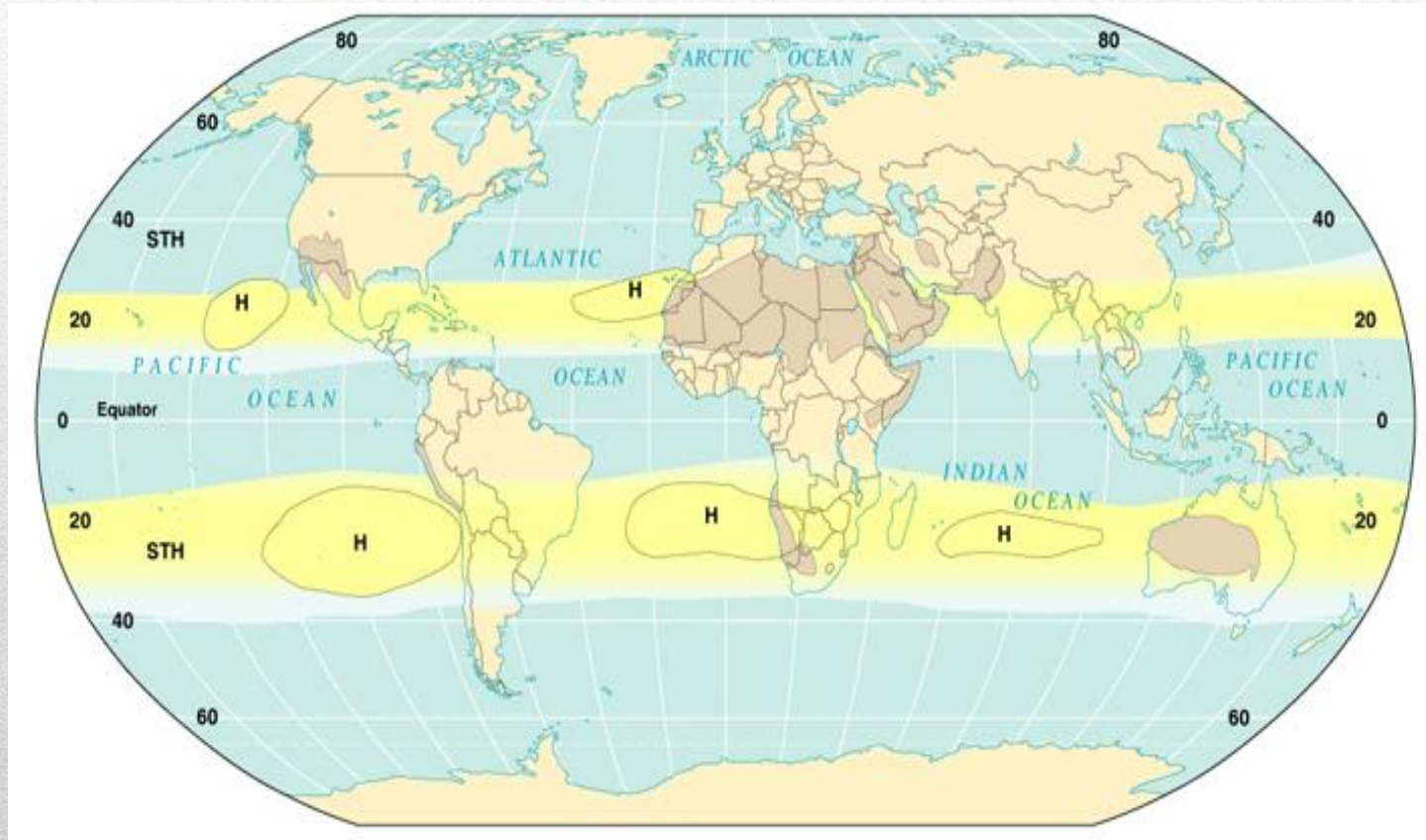


Bs -Dry Mid latitude Climate



Bw- Dry tropical climate

Subtropical high-pressure zones and BWh climates



Mild Mid latitude Climates (Group C)

- **Mediterranean (Csa, Csb)**
 - Centered at 35 latitude on western sides of continents, limited east-west extent except in Mediterranean Sea area
 - Warm/hot summers; mild winters; year-round mildness in coastal areas
 - Moderate precipitation annually, nearly all in winter; much sunshine, some coastal fog
 - STH subsidence and stability in summer; westerly winds and cyclonic storms in winter
-



Cs-Mediterranean Climate



Cf- Moist Continental
Climate

Mild Mid latitude Climates

- Humid subtropical (Cfa, Cwa)
 - Centered at 30 latitude on eastern sides of continents; considerable east-west extent
 - Summers warm/hot, sultry; winters mild to cold
 - Abundant precipitation annually, mostly rain; summer maxima but no true dry season
 - Westerly winds and storms in winter; moist onshore flow in summer; monsoons in Asia
 - Marine west coast (Cfb, Cfc)
 - Latitudes 40-60 on western sides of continents; limited inland extent except in Europe
 - Very mild winters for the latitude; generally mild summers
 - Moderate to abundant precipitation, mostly in winter; many days with rain; much cloudiness
 - Westerly flow and oceanic influence year-round
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Severe Mid latitude Climates (D Group)

- **Humid Continental (Dfa, Dfb, Dwa, Dwb)**
 - Northern Hemisphere only; latitudes 35-55, on eastern sides of continents
 - Warm/hot summers; cold winter; much day-to-day variations
 - Moderate to abundant precipitation annually; with summer maxima; diminishes interior-ward and pole-ward
 - Westerly winds and storms, especially in winter; monsoons in Asia
 - **Subarctic (Dfc, Dfd, Dwc, Dwd)**
 - Northern Hemisphere only, latitudes 50-70 across North America and Eurasia
 - Long, dark, very cold winters; brief, mild summers
 - Meager precipitation annually, with summer maxima; light snow in winter but little melting
 - Pronounced Continentality; Westerlies and cyclonic storms alternating with prominent anti-cyclonic conditions
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Dfc – Subarctic, cold
climate



ET – Tundra Climate



Polar Climates (Group E)

- **Tundra (ET)**

- Fringes of Arctic Ocean; small coastal areas in Antarctica
- Long, cold, dark winters; brief cool summer;
- Very sparse precipitation annually, mostly snow
- Latitude; distance from sources of heat and moisture; extreme seasonal contrasts in sunlight/darkness

- **Ice cap (EF)**

- Antarctica and Greenland
 - Long, dark, windy, bitterly cold winters; cold windy summers
 - Very sparse precipitation, all snow
 - Latitude; distance from sources of heat and moisture; extreme seasonal contrasts in sunlight/darkness; polar anticyclones
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Highland Climate (Group H)

- **High uplands** (mountains and plateaus) with complex local climate variation in small areas
 - Related closely to the adjacent lowland with regard to seasonality of precipitation
 - Altitude variations influence all four elements of the weather and the climate of the highlands (vertical zonation)
 - Exposure is another profound influence on the highland climate
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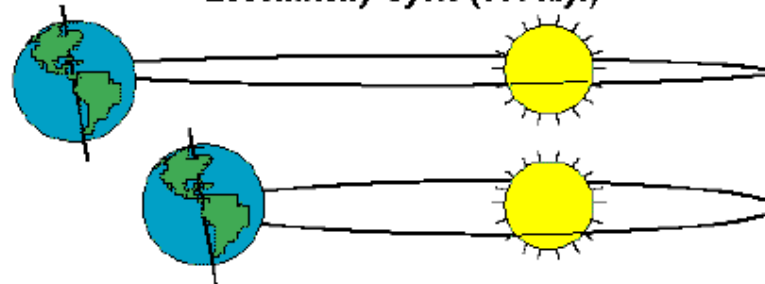
Global Climate Change

- **Determining Climate Change**
 - **Dendrochronology**
 - **Determining climate change through tree rings**
 - **Oxygen Isotope Analysis of Oceanic Sediments**
 - **Ice Cores**
 - **Analysis of the ratio of the water molecules weight.**
 - **Pollen Analysis (palynology)**
 - **Using radiocarbon dating on pollen matter found in sediment layers**
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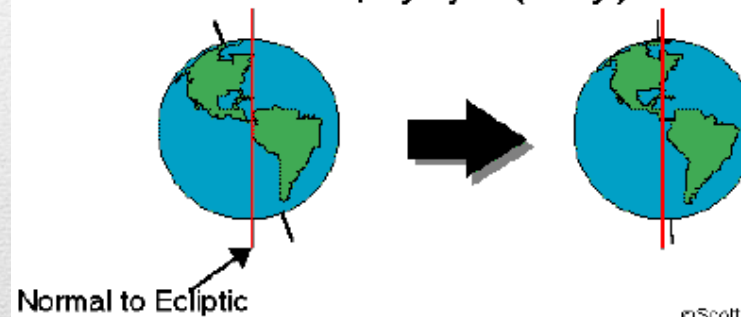
Causes of Long-Term Climate Change

- **Volcanic Activity and Meteor Impacts**
 - **Fluctuations in Solar Output**
 - **Variations in Earth-Sun Relations (Milankovich cycles)**
 - **Change in the Earth's axis**
 - **Change in the “shape” of the Earth's elliptical orbit**
 - **Wobble in the Earth's axis**
 - **Greenhouse Gases Concentration**
 - **Feedback Mechanisms**
 - **Roles of the Ocean**
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Eccentricity Cycle (100 k.y.)

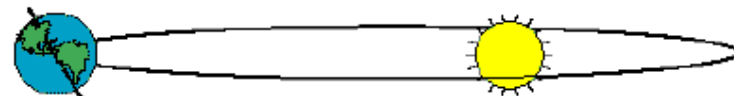


Obliquity Cycle (41 k.y.)

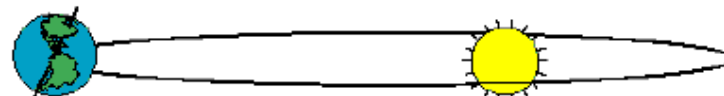


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Precession of the Equinoxes (19 and 23 k.y.)

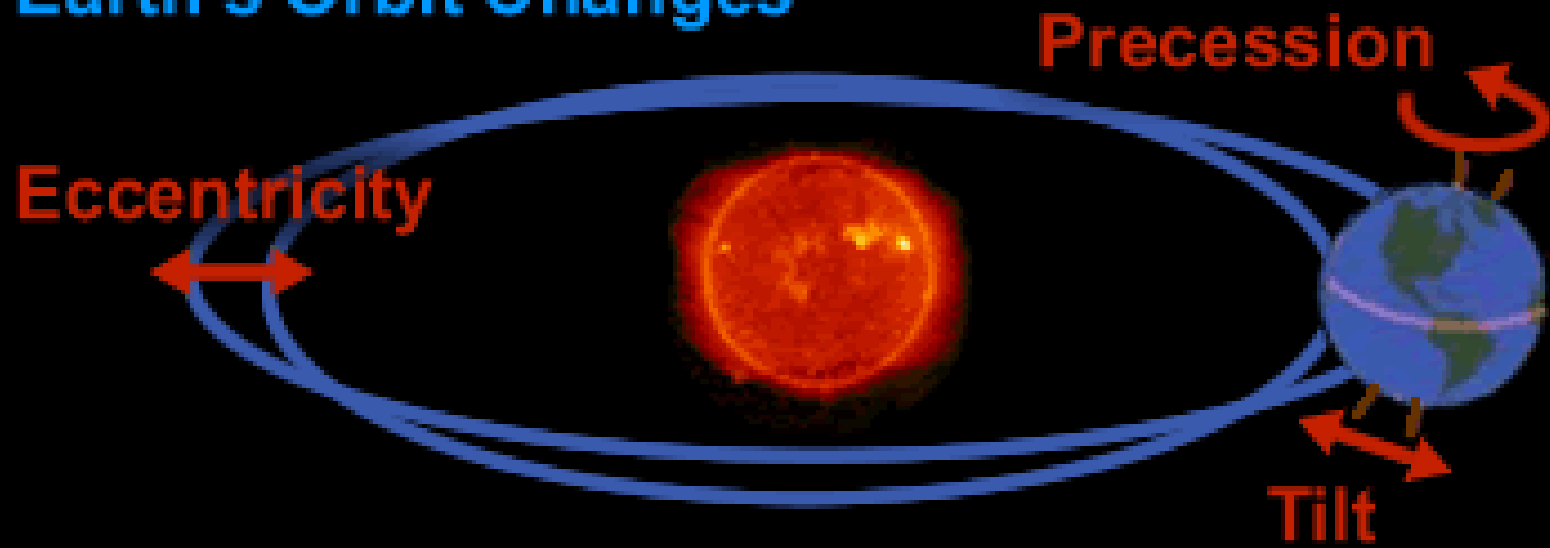


Northern Hemisphere tilted away from the sun at aphelion.



Northern hemisphere tilted toward the sun at aphelion.

The Three Ways Earth's Orbit Changes



Climate Models

- **General Circulation Models (GCMs)**
 - **Used to determine future climate changes**
 - **Evidences of Current Global Warming**
 - **Consequences of Global Warming**
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